

Temporary Transvenous Pacemaker Insertion (Perform)

P U R P O S E: The purpose of temporary cardiac pacing is to ensure or restore adequate heart rate and rhythm. A transvenous pacemaker is inserted as a temporary measure when the normal conduction system of the heart fails to produce an electrical impulse, resulting in hemodynamic compromise or other debilitating symptoms in the patient.


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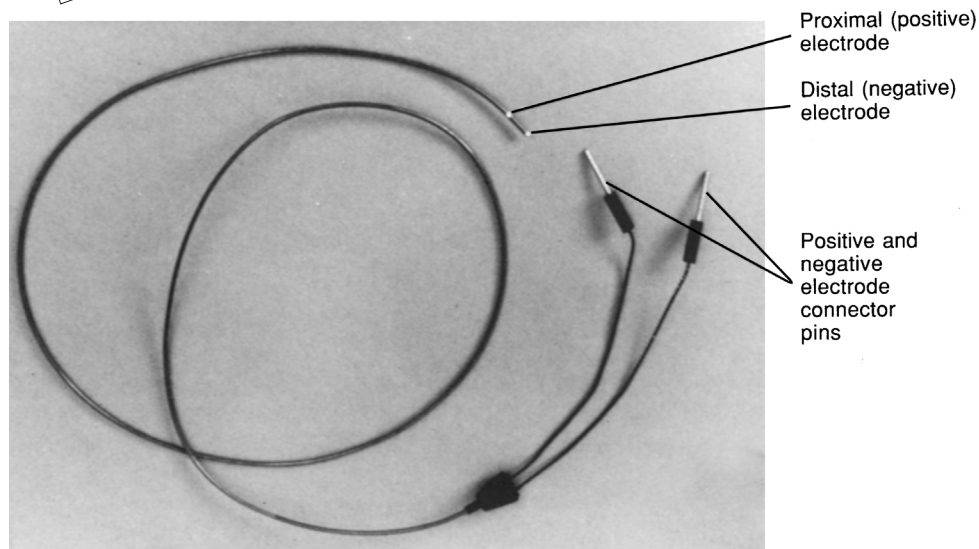
PREREQUISITE NURSING KNOWLEDGE

- Understanding of normal anatomy and physiology of the cardiovascular system, principles of cardiac conduction, and basic and advanced dysrhythmia interpretation is necessary.
- Understanding of temporary pacemakers is needed to evaluate pacemaker function and patient response to pacemaker therapy.
- Clinical and technical competence in central line insertion, temporary transvenous pacemaker insertion, and suturing is necessary.
- Clinical and technical competence is needed related to use of temporary pacemakers.
- Competence in chest x-ray interpretation should exist.
- Advanced cardiac life support knowledge and skills are necessary.
- Principles of general electrical safety apply when using temporary invasive pacing methods. Gloves should always be worn when handling electrodes to prevent microshock.
- The insertion of a temporary pacemaker is performed in both emergency and elective clinical situations. Temporary pacing may be used to stimulate the myocardium to contract in the absence of an intrinsic rhythm, to establish adequate cardiac output and blood pressure to ensure tissue perfusion to vital organs, to reduce the possibility of ventricular dysrhythmias in the presence of bradycardia, to supplement an inadequate rhythm with transient decreases in heart rate (ie, chronotropic incompetence in shock), or to allow the administration of medications (ie, beta blockers) to treat ischemia or tachydysrhythmias

in the presence of conduction system dysfunction or bradycardia.

- Temporary transvenous pacing is indicated for the following:
 - ❖ Third-degree atrioventricular (AV) block (symptomatic congenital complete heart block, symptomatic acquired complete heart block)
 - ❖ Type II AV block
 - ❖ Dysrhythmias complicating acute myocardial infarction (symptomatic bradycardia, complete heart block, new bundle branch block with transient complete heart block, alternating bundle branch block)
 - ❖ Sinus node dysfunction (symptomatic bradydysrhythmias, treatment of tachy-brady syndromes [sick sinus syndromes])
 - ❖ Ventricular standstill or cardiac arrest
 - ❖ Long QT syndrome with ventricular dysrhythmias
 - ❖ Drug toxicity
 - ❖ Postoperative cardiac surgery
 - ❖ Prophylaxis with cardiac diagnostic or interventional procedures
 - ❖ Chronotropic incompetence in the setting of cardiogenic shock
- When temporary transvenous pacing is used, the pulse generator is externally attached to a pacing lead wire that is inserted through a vein into the right atrium or ventricle.
- Veins used for the insertion of a transvenous pacing lead wire are subclavian, femoral, brachial, internal jugular, or external jugular.
- Single-chamber ventricular pacing is usually the most appropriate method in an emergency because the goal is to establish a heart rate as quickly as possible.
- The pacing lead is an insulated wire with two electrodes at the tip of the wire (Fig. 46-1).
- The pacing lead can be a hard-tipped or a balloon-tipped pacing catheter that is placed in direct contact with the myocardium. Most temporary leads are bipolar with the

 This procedure should be performed only by physicians, advanced practice nurses, and other health care professionals (including critical care nurses) with additional knowledge, skills, and demonstrated competence per professional licensure or institutional standard.



■ ● **FIGURE 46-1.** Bipolar lead wire.

distal tip electrode separated from the proximal ring by 1 to 2 cm (see Fig. 46-1).

- Basic principles of cardiac pacing include sensing, pacing, and capture.
 - ❖ *Sensing* refers to the ability of the pacemaker device to detect intrinsic myocardial electrical activity. Sensing occurs if the pulse generator is in the synchronous or demand mode. The pacemaker either will be inhibited from delivering a stimulus or will initiate an electrical impulse.
 - ❖ *Pacing* occurs once the temporary pulse generator is activated and the requisite level of energy travels from the pulse generator through the temporary pacing lead wire to the myocardium. This is known as pacemaker “firing” and is represented as a “line” or “spike” on the electrocardiogram (ECG) recording.
 - ❖ *Capture* refers to the successful stimulation of the myocardium by the pacemaker, resulting in depolarization. It is evidenced on the ECG by a pacemaker spike followed by either an atrial or a ventricular complex, depending on the chamber being paced.
- Temporary pulse generator features include the following:
 - ❖ The temporary pulse generator houses the controls and the energy source for pacing.
 - ❖ There are pulse generators that can be used for single-chamber pacing with one set of terminals at the top of the pulse generator, into which the pacing wires are inserted (via connecting cable).
 - ❖ A dual-chamber pacemaker requires two sets of terminals for atrial and ventricular wires.
 - ❖ Different models of pacemakers use either dials or touch pads to change settings.
 - ❖ Pacing rate is determined by the rate dial or pad.
 - ❖ The AV interval dial or pad on a dual-chamber pace-

maker controls the amount of time between atrial and ventricular stimulation (electronic P-R interval).

- ❖ The energy delivered to the myocardium is determined by setting the output (mA or milliamperage) dial or pad on the pulse generator.
- ❖ Dual-chamber pacing requires that mAs be set for both the atria and the ventricle.
- The ability of the pacemaker to detect the patient’s intrinsic rhythm is determined by the pacing mode. In the asynchronous mode, the pacemaker functions as a fixed-rate pacemaker and is not able to sense any of the patient’s inherent cardiac activity. In the synchronous mode, the pacemaker is able to sense the patient’s inherent cardiac activity.
- The ability of the pacemaker to depolarize the myocardium is dependent on a number of variables: position of the electrode and degree of contact with viable myocardial tissue; level of energy delivered through the pacing wire; presence of hypoxia, acidosis, or electrolyte imbalances; fibrosis around the tip of the catheter; and concomitant drug therapy.¹

EQUIPMENT

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| • Antiseptic skin preparation solution (povidone-iodine) | • Percutaneous introducer needle or 14-G needle |
| • Local anesthetic | • Introducer sheath with dilator |
| • Sterile drapes, towels, masks, gowns, gloves, and dressings | • Guidewire (per physician or advanced practice nurse) |
| • Balloon-tipped pacing catheter and insertion tray | • Alligator clips |
| • Pacing lead wire | • Suture with needle, syringes, needles |
| • Pulse generator | • ECG monitor and recorder |
| • 9-volt battery for pulse generator | • Supplies for dressing at insertion site |
| • Connecting cable | |

Additional equipment (to have available depending on patient need) includes the following:

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| • Emergency equipment | • 12-lead ECG machine |
| • Fluoroscopy | |

■ AP This procedure should be performed only by physicians, advanced practice nurses, and other health care professionals (including critical care nurses) with additional knowledge, skills, and demonstrated competence per professional licensure or institutional standard.

PATIENT AND FAMILY EDUCATION

- Assess learning needs, readiness to learn, and factors that will influence learning. **➤Rationale:** Individualizes teaching in a manner that will be meaningful to the patient and the family.
- Discuss basic facts about the normal conduction system, such as structure of the conduction system, source of heart rate, normal and abnormal heart rhythms, and symptoms and significance of abnormal heart rhythms. **➤Rationale:** Patient and family should understand why the procedure is necessary and what potential risks and benefits will be derived from undergoing this invasive procedure.
- Provide a basic description of the temporary pacemaker insertion procedure. **➤Rationale:** Patient and family should be informed of the invasive nature of the procedure and any risks associated with the procedure. An understanding of the procedure may reduce anxiety associated with the procedure.
- Describe the precautions and restrictions required while the temporary pacemaker is in place, such as limitation of movement, avoiding handling the pacemaker or touching exposed portions of the electrode, and situations in which the nurse should be notified (eg, if the dressing becomes damp, if the patient experiences dizziness). **➤Rationale:** Understanding potential limitations may improve patient compliance with restrictions and precautions.

PATIENT ASSESSMENT AND PREPARATION

Patient Assessment

- Assess cardiac rhythm for the presence of the dysrhythmia that necessitates placement of temporary cardiac pacing. **➤Rationale:** Determines the need for invasive cardiac pacing.
- Assess the hemodynamic response to the dysrhythmia. Rhythm disturbances may significantly reduce cardiac output, with detrimental effects on perfusion to vital organs. **➤Rationale:** Determines the urgency of the

procedure. May indicate the need for temporizing measures (such as vasopressors or transcutaneous pacing).

- Review current medications. **➤Rationale:** Medications may be implicated as a cause for the dysrhythmia that led to the need for pacemaker therapy, or medications may need to be held as a result of concomitant effect. Other medications, such as antidysrhythmics, may alter the pacing threshold.
- Review current laboratory studies, including chemistry or electrolyte profile, arterial blood gases, and cardioactive drug levels. **➤Rationale:** Assists in determining if the need for pacing was precipitated by metabolic disturbances or drug toxicity and establishes the pacing milieu.
- Presence and position of central venous access (if present). **➤Rationale:** The temporary transvenous pacing catheter is advanced through the central venous circulation. If access is already established, it is necessary to ensure proper placement before the pacing catheter can be advanced through the circulatory system.

Patient Preparation

- Ensure that the patient and the family understand preprocedural teaching. Answer questions as they arise, and reinforce information as needed. **➤Rationale:** Evaluates and reinforces understanding of previously taught information.
- Obtain informed consent. **➤Rationale:** Protects rights of patient and makes competent decision possible for patient; however, under emergency circumstances, time may not allow consent form to be signed.
- Connect the patient to a five-lead monitoring system or to a 12-lead ECG machine. **➤Rationale:** Facilitates the placement of the balloon-tipped catheter by indicating the position of the catheter during its placement. Also, allows for monitoring of the patient's cardiac rhythm during the procedure.
- Administer pain medication or sedation as prescribed. **➤Rationale:** May be indicated depending on patient level of anxiety and pain. Sedation or pain medication may not be possible if patient is hypotensive.

Procedure for Insertion of a Temporary Transvenous Pacemaker

Steps	Rationale	Special Considerations
1. Wash hands.	Reduces transmissions of microorganisms; standard precautions.	
2. Connect patient to bedside monitoring system, and monitor ECG continuously.	Monitors intrinsic rhythm as well as rhythm during and after the procedure to evaluate for adequate rate and pacemaker function.	If the monitoring system is not a five-lead system, also connect the patient to the 12-lead ECG machine (see Procedure 54).
3. Assess pacemaker functioning, and insert a new battery into the pulse generator if needed.	Ensures functional pacemaker pulse generator.	There are different ways to assess battery function depending on model and manufacturer. Check manufacturer recommendations for specific instructions.
4. Attach the connecting cable to the pulse generator, connecting the "positive" on the cable to the "positive" on the pulse generator and the "negative" on the cable to the "negative" on the pulse generator.	Prepares the pacing system. The pacing stimulus will travel from the pulse generator to the negative terminal, and energy will return to the pulse generator via the positive terminal.	

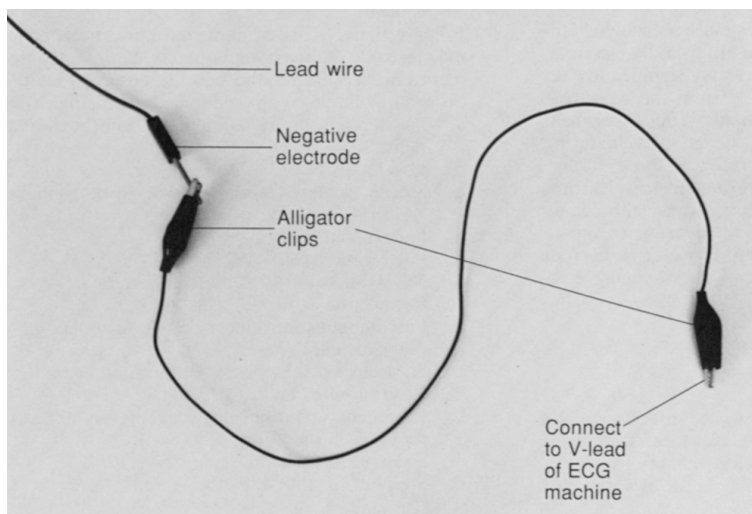
**Procedure** for Insertion of a Temporary Transvenous Pacemaker *Continued*

Steps	Rationale	Special Considerations
5. Check the placement of the central venous access by chest x-ray before starting the procedure. If central venous access is needed, refer to Procedure 73.	Central venous access is needed for transvenous pacing.	
6. Prepare insertion site by clipping hair close to the skin in the area surrounding the insertion site.	Essential to prevent infection.	Shaving should be avoided because nicks in the skin may predispose patient to infection.
7. All personnel performing and assisting with the procedure should don masks, gowns, gloves, and caps.	Prevents infection and maintains standard precautions.	Gloves should be worn whenever the pacing electrodes are handled, to prevent microshock.
8. Cleanse site with antiseptic solution such as povidone-iodine solution.	Prevents infection.	
9. Drape the site with the sterile drapes.	Provides a sterile field and reduces the transmission of microorganisms.	
10. Administer local anesthetic to numb the insertion site.	A large-gauge introducer is used, which may cause discomfort during the insertion procedure.	Not necessary if central venous access is already in place.
11. Make a percutaneous puncture through the vein selected for the procedure (eg, jugular, subclavian, antecubital, or femoral vein). Refer to Procedure 73.	Allows for direct placement of the introducer.	
12. Insert the balloon-tipped catheter through the introducer, and advance the pacing lead.		
13. Inflate the balloon when the tip of the pacing lead is in the vena cava.	The air-filled balloon allows the blood flow to carry the catheter tip into the desired position in the right ventricle.	
14. Verify transvenous pacing lead placement by <ol style="list-style-type: none">Using the V lead of the bedside monitoring system or the 12-lead ECG machine.Connect the patient to the limb leads.An alligator clip may be needed (Fig. 46–2).Attach the V lead of the ECG monitoring system or the 12-lead ECG machine to the negative electrode connector pin (distal pin) of the pacing electrode.Set the monitoring system to continuously record the V lead.Observe the ECG for ST segment elevation in the V lead recording (Fig. 46–3).Observe for left bundle branch block pattern and left axis deviation that can usually be identified.	The negative pacing electrode is positioned in the apex of the right ventricle. The ECG is then derived directly from the pacing electrode, and the position of the catheter tip is verified by the internal electrical recording that demonstrates ST segment elevation indicating contact with the myocardium.	Fluoroscopy may be needed to permit direct visualization of the pacing electrode. If fluoroscopy is used, all personnel must be shielded from the radiation with lead aprons or be positioned behind lead shields.



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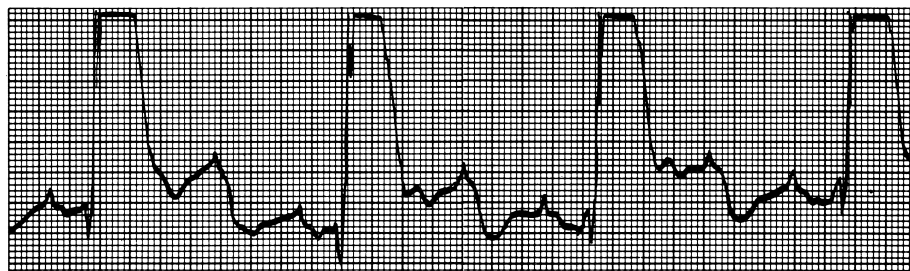
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■ ● FIGURE 46-2. Alligator clips. ECG, electrocardiogram.

Procedure for Insertion of a Temporary Transvenous Pacemaker *Continued*

Steps	Rationale	Special Considerations
15. After the electrodes are properly positioned, deflate the balloon and connect the external electrode pins to the pulse generator via the connecting cable. Ensure that the positive and negative electrodes are connected to the respective positive and negative terminals on the pulse generator via the connecting cable.	Energy from the pulse generator is directed to the negative electrode in contact with the ventricle. The pacing circuit is completed as energy reaches the positive electrode. The lead wires must be connected securely to the pacemaker to ensure appropriate sensing and capture and to prevent inadvertent disconnection.	It is recommended that a bridging connecting cable be used between the pacing wires and the pulse generator. Some lead wires may not have "negative" and "positive" marked on them. Polarity is established when the wires are placed in the connecting cable.
16. Refer to Procedure 47 for setting pacemaker settings and initiating pacing.		
17. Suture the pacing lead in place.	Prevents dislodgment.	
18. Apply a sterile, occlusive dressing over the site.	Prevents infection.	
19. Secure necessary equipment to provide some stability for the pacemaker, such as hanging pulse generator on an intravenous (IV) pole, strapping pulse generator to patient's torso, or hanging pulse generator from a carrying device.	The pulse generator should be protected from falling or becoming inadvertently detached by patient movement. Disconnection or tension on the pacing electrodes may lead to pacemaker malfunction.	
20. Discard used supplies, and wash hands.	Reduces transmission of microorganisms; standard precautions.	



■ ● FIGURE 46-3. ECG rhythm recorded in the right ventricle: elevated ST segments when pacing electrode is wedged against the endocardial wall of the right ventricle. ECG, electrocardiogram. (From Meltzer LE, Pinneo R, Kitchell JR. *Intensive Coronary Care*. 4th ed. Bowie, Md: Robert J. Brady Co.; 1983: 233.)

Procedure Insertion of a Temporary Transvenous Pacemaker *Continued*

Steps	Rationale	Special Considerations
21. Obtain chest x-ray.	In the absence of fluoroscopy, an x-ray is essential to detect potential complications associated with insertion as well as to visualize lead position.	

Expected Outcomes	Unexpected Outcomes
<ul style="list-style-type: none"> ECG will show paced rhythm consistent with parameters set on pacemaker, as evidenced by appropriate heart rate, proper sensing, and proper capture. Patient will exhibit hemodynamic stability, as evidenced by systolic blood pressure greater than 90 mm Hg, mean arterial blood pressure greater than 60 mm Hg, alertness and orientation, and no syncope or ischemia. Pacemaker leads will be isolated from other electrical equipment by maintaining secure connections into pulse generator. 	<ul style="list-style-type: none"> Inability to achieve proper placement of the pacing catheter Failure of the pacemaker to sense, causing competition between the pacemaker-initiated impulses and the patient's intrinsic cardiac rhythm Failure of the pacemaker to capture the myocardium Pacemaker oversensing causing the pacemaker to be inappropriately inhibited Stimulation of diaphragm causing hiccuping, possibly related to pacing the phrenic nerve, perforation, wire dislodgment, or excessively high pacemaker mA setting Development of phlebitis, thrombosis, embolism, or bacteremia Ventricular dysrhythmias from manipulation within the cardiac chamber Pneumothorax or hemothorax from the insertion procedure Myocardial perforation and cardiac tamponade from the insertion procedure and electrode placement Air embolism Lead dislodgment

Patient Monitoring and Care

Patient Monitoring and Care	Rationale	Reportable Conditions
1. Monitor vital signs and hemodynamic response to pacing as often as patient condition warrants.	The goal of cardiac pacing is to improve cardiac output by increasing heart rate or by overriding life-threatening dysrhythmias.	<p><i>These conditions should be reported if they persist despite nursing interventions.</i></p> <ul style="list-style-type: none"> Change in vital signs associated with signs and symptoms of hemodynamic deterioration
2. Evaluate ECG for presence of paced rhythm or resolution of initiating dysrhythmia.	Proper pacemaker functioning is assessed by observing the ECG for pacemaker activity consistent with the parameters set.	<ul style="list-style-type: none"> Inability to obtain a paced rhythm Oversensing Undersensing
3. Monitor patient's level of comfort. <ul style="list-style-type: none"> Assess level of comfort. Administer analgesic or sedative as needed. Evaluate patient response to interventions. 	Discomfort may increase patient's anxiety and decrease tolerance of the procedure, causing hemodynamic compromise.	<ul style="list-style-type: none"> Continual hiccups (may indicate wire perforation) Unrelieved discomfort

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Patient Monitoring and Care *Continued*

Patient Monitoring and Care	Rationale	Reportable Conditions
4. Check and document sensitivity and threshold at least every 24 hours. Threshold may be checked by physicians in high-risk patients.	Prevents unnecessarily high levels of energy delivery to the myocardium. Threshold may be checked more frequently if the patient condition changes or pacer function is questioned.	• Problems with sensitivity or threshold
5. Change dressing as determined by institutional policy depending on the type of dressing used. <ul style="list-style-type: none"> ○ Cleanse surrounding area with antiseptic solution such as povidone-iodine. ○ Apply dry, sterile dressing and tape. ○ Record date of dressing change. 	Decreases potential for infection.	• Signs of infection such as increased temperature, increased white blood cells, purulent drainage at the insertion site, or warmth or pain at the site
6. Monitor for other complications.	Early recognition leads to prompt treatment.	• Any signs of complications such as embolus, thrombosis, perforation of the myocardium, pneumothorax, hemothorax, or phlebitis
7. Monitor electrolytes.	Electrolyte imbalances may precipitate dysrhythmias.	• Abnormal electrolyte values
8. Ensure that all connections are secure at least daily.	Maintenance of tight connections is necessary to ensure proper pacer functioning.	• Inability to maintain tight connections with available equipment, jeopardizing pacing therapy

Documentation

Documentation should include the following:

- Patient and family education and response to education
- Date and time of insertion
- Date and time of initiation of pacing
- Description of events warranting intervention
- Vital signs and hemodynamic parameters before, during, and after procedure
- ECG monitoring strip recording before and after pacemaker insertion
- Type of wire inserted and location of insertion
- Pacemaker settings—mode, rate, output, sensitivity setting, threshold measurements, and whether pacemaker is on or off
- Patient response to procedure
- Complications and interventions
- Medications administered and patient response to medication
- Date and time pacing was discontinued

Reference

1. Morhadd MG, Dahlberg ST. Temporary cardiac pacing. In Rippe JM, Irwin RS, Fink MP, Cerra FB, Curley F, Herd SO, eds. *Procedure and Techniques in Intensive Care Medicine*. Philadelphia, Pa: Lippincott Williams & Wilkins; 1994:73–80.

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Additional Readings

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